

REMARKSRegarding the Claim Amendments presented in this reply:

The amendments to the claims add no new matter. Claim 3 has been canceled. The amendment to claim 1 finds support in the specification on page 7, line 29 – page 8, line 2. Applicants respectfully submit that this amendment should be entered despite the finality of the present Office action. First, the amendment would not require further examination or search, because claim 3 as previously presented recited:

The bipolar plate as claimed in claim 1, wherein the polymer blend comprises from 25 to 95 wt% of blend polymers and from 5 to 75 wt% of carbon fillers.

The amendment to claim 1 adds the following limitation:

wherein the polymer blend comprises from 35 to 90 wt% of blend polymers and from 10 to 65 wt% of carbon fillers.

Since, claim 1 as amended would fall within the scope of claim 3 as previously presented, entry of the amendment would not require further examination or search.

Second, Applicants respectfully submit that entry of the amendment to claim 1 puts the application in condition for allowance. Alternatively, the amendment would clearly put the present application in better condition for appeal.

For at least these reasons, Applicants respectfully request that the amendment to claim 1 be entered and considered.

Regarding the Claim Rejection:

Claims 1 – 4 and 7 – 9 stand rejected under 35 U.S.C. §103(a) over *Saito et al.* (EP 1,011,164) in view of *Thielen et al.* (US 6,331,586).

The *Saito et al.* Reference

Saito discloses a separator for fuel cells, comprising a binder, a powdery carbon filler, and a short fiber. According to paragraphs [0016] to [0019], the binder used in the invention according to Saito has no particular restriction and can be chosen from a thermosetting resin, a thermoplastic resin, or a rubber. More specifically, Saito provides:

13 examples of thermosetting resins

[0017] As the thermosetting resin, there can be mentioned, for example, phenolic resin, polycarbodiimide resin, furfuryl alcohol resin, epoxy resin, cellulose, urea resin, melamine resin, unsaturated polyester resin, silicone resin, diallyl phthalate resin, bismaleimide triazine resin, polyaminobismaleimide resin and aromatic polyimide resin. They can be used singly or in admixture of two or more kinds.

30 examples of thermoplastic resins

[0018] As the thermoplastic resin, there can be mentioned, for example, polyethylene, polystyrene, polypropylene, polymethyl methacrylate, polyethylene terephthalate, polybutylene terephthalate, polyethersulfone, polycarbonate, polyoxamethylene, polyamide, polyimide, polyamideimide, polyvinyl alcohol, polyvinyl chloride, polyphenylsulfone, polyetherether ketone, polysulfone, polyether ketone, polyarylate, polyetherimide, polymethylpentene, fluororesin, polyoxybenzoyl ester resin, liquid crystal polyester resin, aromatic polyester, polyacetal, polyallylsulfone, polybenzimidazole, polyethernitrile, polythioethersulfone and polyphenylene ether. They can be used singly or in admixture of two or more kinds.

16 examples of rubbers

[0019] As the rubber, there can be mentioned, for example, fluororubber, silicone rubber, butyl rubber, chloroprene rubber, nitrile rubber, nitrile-chloroprene rubber, chlorinated butyl rubber, epichlorohydrin rubber, epichlorohydrin-ethylene oxide rubber, epichlorohydrin-ethylene oxide-acrylic glycidyl ether terpolymer, urethane rubber, acrylic rubber, ethylene-propylene rubber, styrene rubber, butadiene rubber and natural rubber. They can be used singly or in admixture of two or more kinds.

In reconstructing the present invention by hindsight reasoning, the Office action notes that amongst at least 59 examples of possible binders, *Saito et al.* mention polyethersulfone, polyamide and polyether ketone.

Saito generally disclose that these thermosetting resins, thermoplastic resins, and rubbers can be used alone or in combination. Of course, no binder comprising a blend of two different thermosetting resins, thermoplastic resins, and rubbers is disclosed. In the examples on pages 6 to 10, Saito discloses many different compositions, none of which involve a blend of two different thermosetting resins, thermoplastic resins, and rubbers.

¹ Paragraph [0017] of *Saito et al.* (EP 1011164).

² Paragraph [0018] of *Saito et al.* (EP 1011164), (emphasis added).

³ Paragraph [0019] of *Saito et al.* (EP 1011164).

Based on the enormous number of possible binders disclosed, a person of ordinary skill in the art would understand Saito as teaching that nearly every polymer known to the skilled artisan can be used as binder. Moreover, despite the cursory remark that thermosetting resins, thermoplastic resins, and rubbers might be used alone or in combination as binder, the skilled artisan would learn that blends of different polymers are not actually advantageous; no blends were tested.

Perhaps, even more importantly, Saito provides no apparent reason for a skilled artisan to believe that a specific combination of two non-miscible polymers, having different polarities, might be especially desirable.

The *Thielen et al.* Reference

Thielen discloses conductive polymer blends with finely divided conductive material selectively localized in continuous polymer phase or continuous interphase. Thielen discloses an infinite variety of polymers by stating that “[i]n general, any pair of polymers may be selected for a blend provided that the two polymers present at least some degree of immiscibility and preferably differ in their polarity.”⁴ Thielen also makes clear that an infinite variety of polymers can be used, stating:

The polymers in the conductive blend of the invention can be homopolymers, copolymers, terpolymers, and/or polymers containing any number of different repeating units. Further, the polymer can be any type of polymer, such as a random polymer, alternating polymer, grafted polymer, block polymer, star-like polymer and/or comb-like polymer. The polymer can have the structure of an interpenetrating polymer network, simultaneous interpenetrating polymer network, or interpenetrating elastomeric network.⁵

The reference provides a list of specific examples of polymers:

Specific examples of polymers include, but are not limited to, linear high molecular weight polymers such as polyethylene, poly(vinylchloride), polyisobutylene, polystyrene, polycaprolactam (nylon), polyisoprene, and the like.⁶

⁴ Column 6, lines 45 – 48 of *Thielen et al.*, US 6,331,586.

⁵ Column 6, lines 8 – 16 of *Thielen et al.*, US 6,331,586.

⁶ Column 6, lines 17 – 21 of *Thielen et al.*, US 6,331,586.

However, in reconstructing the present invention by hindsight reasoning, the Office action focuses on only two general classes of polymers within a listing of at least 30 general classes of polymers.

Other general classes of polymers include polyamides, polycarbonates, polyelectrolytes, polyesters, polyethers, (polyhydroxy)benzenes, polyimides, polymers containing sulfur (such as polysulfides, (polyphenylene) sulfide, and polysulfones), polyolefins, polymethylbenzenes, polystyrene and styrene copolymers (ABS included), acetal polymers, acrylic polymers, acrylonitrile polymers and copolymers, polyolefins containing halogen (such as polyvinyl chloride and polyvinylidene chloride), fluoropolymers, ionomeric polymers, polymers containing ketone group(s), liquid crystal polymers, polyamide-imides, polymers containing olefinic double bond(s) (such as polybutadiene, polydicyclopentadiene), polyolefin copolymers, polyphenylene oxides, polyurethanes, thermoplastic elastomers and the like.

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Applicants respectfully submit that Thielen also teaches that these polymer blends are used in combination with a very low amount of carbon black. For example, according to example 1 of Thielen, 1% by weight of carbon black is used in a blend of PP and EPR. According to Thielen, polymer blends made of at least two polymers chosen from the group as mentioned above, can be used in connection with very low amounts of carbon black, for example 1% by weight, in order to obtain conductive polymer blends. The specific combinations according to Thielen comprise polyethylene and polystyrene, polystyrene and polyacrylates, polypropylene and polyamide, or polypropylene and polycarbonate. A person having ordinary skill in the art is, therefore, taught that polymers based on olefinic monomers like ethylene, propylene, styrene, or acrylic acid esters should be combined in order to obtain the blend with the specific features as mentioned above.

In addition, Thielen discloses very generally that these conductive polymers can be used in components for electronic equipment (*See* column 11, lines 31 to 37).

The Proposed Combination

The Office action states that “[a]lthough the particular species of polyether, polysulfone, and/or ketone-containing polymer recited in claim 1 are not expressly

⁷ Column 6, lines 21 – 34 of *Thielen et al.*, US 6,331,586 (emphasis added).

disclosed by Thielen,”⁸ a skilled artisan would have looked to Saito and would have found it obvious to choose the claimed species “from a finite number of identified, predictable solutions, with a reasonable expectation of success.”⁹

The Office action asserts that a skilled artisan would have been motivated to modify the teaching of Saito by using the co-continuous polymer blend of Thielen because of the following three statements in Thielen:

- “Another object of the invention is to provide a conductive polymer blend which is suitable for processing by any method, including blow molding.”¹⁰
- “...the conductive polymer blends have improved mechanical properties.”¹¹
- “A wide variety of articles may be produced from the polymer blend of the invention, [including] ... components for electronic equipment.”¹²

The Office action states that the combination “fairly suggests the claimed combination of a polyamide and a polyether ketone or a polyether sulfone.”¹³ To the contrary, Applicants respectfully submit that none of the cited documents even point in the direction of the very specific combination of polyamide and polyether ketone, or polyamide and polyether sulfone, according to claim 1 of the present application. The mere listing of each of these components is in no way a “fair suggestion” of the combination.

“To establish a *prima facie* case of obviousness in a genus-species chemical composition situation ... it is essential that Office personnel find some motivation or suggestion to make the claimed invention in light of the prior art teachings.”¹⁴ Applicants respectfully stress that the “the claimed invention” requires a very specific combination, which is not suggested by the cited references. It is also worth mentioning that MPEP § 2144.08 explains that “[i]f ... a [preferred] species or subgenus is

⁸ Page 4, lines 15 – 17 of the final Office action mailed December 28, 2007 (emphasis added).

⁹ Page 4, lines 15 – 17 of the final Office action mailed December 28, 2007, citing *KSR v. Teleflex*, 82 USPQ2d 1385, 127 S.Ct. 1727 (2007).

¹⁰ Column 3, lines 24 – 26 of US 6,331,586.

¹¹ Column 3, lines 34 – 35 of US 6,331,586.

¹² Column 11, lines 31 – 36 of US 6,331,586.

¹³ Page 4, lines 12 – 13 of the Office action mailed December 28, 2007 (emphasis added).

¹⁴ MPEP § 2144.08.

structurally similar to that claimed, its disclosure may motivate one of ordinary skill in the art to choose the claimed species or subgenus from the genus, based on the reasonable expectation that structurally similar species usually have similar properties.” MPEP § 2144.08 instructs examiners to consider whether the cited references provide “any teachings of a ‘typical,’ ‘preferred,’ or ‘optimum’ species or subgenus within the disclosed genus.”¹⁵ Applicants respectfully submit that due consideration of the teachings of which combinations are preferred by the cited references, further undermines the present rejection.

Indeed, the polymer blends disclosed by Thielen as being very preferred are combinations comprising two polymers, which have very similar chemical structures, for example, a combination of high density polyethylene and ethylene propylene rubber. On the other hand, the present claims require a polymer blend that includes at least one polyamide and at least one polyether ketone or polyether sulfone as blend polymers. Thus, a skilled artisan would not learn from Thielen that polyether sulfones or polyether ketones are suitable polymers in a polymer blend.

In addition, none of the cited documents points in the direction of the claimed use of these specific blends, i.e. in a bipolar plate for PEM fuel cells. Both documents generally disclose that combinations of polymers may be suitable for the use in electronic equipment. This does not, however, point in the direction of the very specific invention according to amended claim 1.

Next, a combination of Saito and Thielen would not result in a bipolar plate comprising a polymer blend having a high carbon black content of 10 to 65% by weight as it is claimed in claim 1 as currently amended. A skilled artisan attempting to obtain a bipolar plate comprising more than 10% by weight of carbon black, would not take Thielen into account. The skilled artisan would not take Thielen into account, because Thielen teaches that the specific combination of two different polymers are advantageously combined with very low amounts of carbon black, i.e. 1% by weight.

Additionally, Thielen teaches combinations of polymers in which at least one polymer is a polymer based on olefinic monomers, whereas in claim 1 as currently amended, the polymer blend comprises two polymers which are not based on olefinic

¹⁵ MPEP § 2144.08.

monomers, but, instead, are based on difunctional monomers like aminosulphonic acids, etc.

In brief summary, the references provide no apparent reason to arrive at the following features of the claimed invention:

- the specific combination of polyether sulfone and polyamide or polyether ketone and polyamide;
- a high amount of carbon filler of 10 to 65% by weight;
- the use of such a polymer blend in a bipolar plate of a fuel cell;
- the combination of two polymers which are not based on olefinic monomers.

Thus, the present rejection is in error and should be withdrawn.

Unexpected Results

A person of ordinary skill in the art would not learn from the cited references that a bipolar plate comprising a polymer blend that includes at least one polyamide and at least one polyether ketone or polyether sulfone as blend polymers for PEM fuel cells according to claim 1 gives rise to the advantageous properties disclosed in the present application.

Applicants urged that a fuel cell having a bipolar plate, which comprises the specific polymer blend of the present invention can be operated under a higher permanent temperature. In response the Office action states that this “result cannot be characterized as unexpected because it is well-known that higher operating temperatures increase reaction rate and fuel cell efficiency.”¹⁶ This argument seems to indicate that the previous reply did not express the technical point well enough. Applicants mean to express that a fuel cell, having a bipolar plate comprising the specific polymer blend of the present invention can be operated under a higher permanent temperature. This unexpected result depends on the precise polymer blend comprising at least one polyamide and at least one polyether ketone or polyether sulfone. Since a skilled artisan had no way to predict that this very specific combination could yield a bipolar plate for PEM fuel cells that can be operated under a higher permanent temperature, Applicants

¹⁶ Page 5, lines 12 – 14 of the final Office action mailed December 28, 2007.

have made an important, and patentable contribution to the art.

Indeed, the use of a polymer blend that includes at least one polyamide and at least one polyether ketone or polyether sulfone as blend polymers, makes it possible for the bipolar plate for PEM fuel cells according to the present application to be used under higher temperatures than bipolar plates for PEM fuel cells, comprising, for example, a polymer blend of polyethylene and polystyrene. If a bipolar plate for PEM fuel cells comprises a polymer blend of polyethylene and polystyrene, the temperature of permanent use of this fuel cell is at about 90°C. If the bipolar plate for PEM fuel cells according to the present application is used, comprising a polymer blend that includes at least one polyamide and at least one polyether ketone or polyether sulfone as blend polymers, this fuel cell can be operated under a higher permanent temperature than the one which has to be applied when a polymer blend comprising polyethylene and polystyrene is used. The higher operating temperature of the fuel cell comprising the bipolar plate according to presently amended claim 1 of the present application makes it possible to increase the reaction rate, which is in direct connection to strength of current, which can be obtained from the fuel cell. This result is unexpected, and is, therefore, further evidence in support of the unobviousness of the present invention.

Applicants also pointed out that a significantly improved stability against peroxide anions is present in the bipolar plate during operation. In response the Office action states that “the selection of blend polymers that are able to withstand a particular fuel cell operating temperature also would be well within the skill of the art.”¹⁷ Applicants respectfully submit that a skilled artisan had no way to predict that this very specific combination could yield a bipolar plate for PEM fuel cells with a significantly improved stability against peroxide anions. No evidence to the contrary has been produced. The broad allegation that “the selection of blend polymers that are able to withstand a particular fuel cell operating temperature also would be well within the skill of the art”¹⁸ is insufficient without supporting evidence. Again, Applicants have made an important, and patentable contribution to the art. The present application makes clear that a bipolar plate comprising a polymer blend that includes at least one polyamide and

¹⁷ Page 5, lines 14 – 15 of the final Office action mailed December 28, 2007.

¹⁸ Page 5, lines 14 – 15 of the final Office action mailed December 28, 2007.

at least one polyether ketone or polyether sulfone as blend polymers has increased stability against peroxide-anions O_2^{2-} , which are present during the operating of a fuel cell. These very reactive anions unexpectedly cause less degradation to a bipolar plate according to the present invention. On the other hand, a polymer blend comprising polyethylene and polystyrene has a significantly lower stability against peroxide anions, causing a faster degradation of the bipolar plate.

Applicants respectfully submit that these unexpected results are strong and convincing evidence that the present invention is nonobvious.

In Conclusion:

The present application is in condition for allowance. Applicants request favorable action in this matter. In order to facilitate the resolution of any issues or questions presented by this paper, the Examiner is welcome to contact the undersigned by phone to further the discussion.

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